

What is claimed is:

- Sub A*
1. A polishing method comprising removing a copper film by chemical mechanical polishing using a polishing liquid containing an oxidizing substance, a phosphoric acid, and a protection-layer forming agent.
2. A polishing method according to claim 1, wherein said oxidizing substance contains hydrogen peroxide, and said phosphoric acid contains one selected from the group of orthophosphoric acid and phosphorous acid.
- 10 3. A polishing method according to claim 2, wherein said protection-layer forming agent contains benzotriazole.
4. A polishing method according to claim 2, wherein said protection-layer forming agent contains a carboxyl-containing polymer.
- 15 5. A polishing method according to claim 2, wherein said protection-layer forming agent contains one selected from the group of polyacrylic acid, polyammonium acrylate, polyamine acrylate, and a bridged polymer thereof.
- Sub A 20*
6. A polishing method, which comprises removing a metal film formed over an insulating film by using a polishing liquid containing an oxidizing substance, a phosphoric acid, benzotriazole, and a polymer.
7. A polishing method according to claim 6, wherein said oxidizing substance contains hydrogen peroxide, said

phosphoric acid contains one selected from the group of orthophosphoric acid and phosphorous acid, and said polymer contains one selected from the group of polyacrylic acid, polyammonium acrylate, polyamine acrylate, and a bridged 5 polymer thereof.

8. A polishing method according to claim 7, wherein said metal film comprises a first metal film of a barrier metal and a second copper film formed over said first metal film.

9. A polishing method comprising removing a first metal film 10 of a barrier metal formed on an insulating film and a second metal film of copper formed on the surface of said first metal film, wherein said second metal film is polished using a first abrasive free polishing liquid which contains an oxidizing substance, a phosphoric acid, and a protection-layer forming 15 agent, and said first metal film is polished using a second polishing liquid obtained by adding an abrasive to said first polishing liquid.

*Sub 3  
a*

10. A polishing method according to claim 9, wherein said oxidizing substance contains hydrogen peroxide, said phosphoric acid contains one selected from the group of 20 orthophosphoric acid and phosphorous acid, and said protection-layer forming agent contains benzotriazole.

11. A polishing method according to claim 9, wherein said oxidizing substance contains hydrogen peroxide, said

phosphoric acid contains one selected from the group of orthophosphoric acid and phosphorous acid, and said protection-layer forming agent contains a carboxyl-containing polymer.

- 5 12. A polishing method according to claim 9, wherein said oxidizing substance contains hydrogen peroxide, said phosphoric acid contains one selected from the group of orthophosphoric acid and phosphorous acid, and said protection-layer forming agent contains one selected from the 10 group of polyacrylic acid, polyammonium acrylate, polyamine acrylate, and a bridged polymer thereof.

13. A method for manufacturing a semiconductor device, which comprises forming, over a semiconductor region, an insulating film having an opening, depositing a first metal film made of 15 a barrier metal and a second metal film of copper over said insulating film and inside of said opening, thereby filling said opening with said deposited metal films, removing said second metal film over said insulating film by chemical mechanical polishing with a first polishing liquid containing an oxidizing 20 substance, a phosphoric acid and a protection-layer forming agent but being free of an abrasive, thereby exposing the surface of said first metal film and said second metal film inside of said opening, and removing said first metal film exposed over said insulating film by chemical mechanical polishing with a
- sub A4*

00147629500

*Sub A*  
second polishing liquid containing an abrasive.

14. A method for manufacturing a semiconductor device according to claim 13, wherein said second polishing liquid has a similar composition to said first polishing liquid except that 5 the former one further contains the abrasive.

15. A method for manufacturing a semiconductor device according to claim 13, wherein said second polishing liquid contains the protection-layer forming agent in a larger amount than said first polishing liquid.

10 16. A method for manufacturing a semiconductor device, which comprises forming, over a semiconductor region, an insulating film having an opening, depositing a first metal film made of a barrier metal and a second metal film made of one selected from the group of Cu, an alloy composed mainly of Cu and a Cu 15 compound over said insulating film and inside of said opening, thereby filling said opening with said deposited metal films, removing said second metal film from the surface of said first metal film over said insulating film by chemical mechanical polishing with a first polishing liquid containing hydrogen 20 peroxide, a phosphoric acid, benzotriazole, and one selected from the group of polyacrylic acid, salt thereof, and a bridged polymer thereof but being free of an abrasive, thereby exposing the surfaces of said first metal film over said insulating film and said second metal film inside of said opening, and removing

*Sub A*

said first metal film exposed over said insulating film by chemical mechanical polishing with a second polishing liquid containing an abrasive.

17. A method for manufacturing a semiconductor device  
5 according to claim 16, wherein said second polishing liquid has a similar composition to said first polishing liquid except that the former one further contains the abrasive.

18. A method for manufacturing a semiconductor device  
according to claim 16, wherein said second polishing liquid  
10 contains benzotriazole, and one selected from the group of polyacrylate, salt thereof and bridged polymer thereof in an amount larger than said first polishing liquid.

*Sub B*

19. A metallization method comprising removing a first metal film which is formed over an insulating film and is made of a barrier metal and a second metal film which is formed over the surface of said first metal film and is made of one selected from the group of Cu, an alloy composed mainly of Cu and a Cu compound, wherein said second metal film is polished with an abrasive-free polishing liquid which contains an oxidizing substance, a phosphoric acid and a protection-layer forming agent, followed by polishing of said first metal film by dry etching.

20. A method for manufacturing a semiconductor device, which comprises forming, over a first interconnect layer disposed over

*100-6*  
*6*  
*6*

a semiconductor region, an insulating layer having a groove extending to said first interconnect layer, depositing and stacking a first metal film made of a barrier metal and a second metal film made of one selected from the group of Cu, an alloy 5 composed mainly of Cu and a Cu compound over said insulating film and inside of said groove, thereby filling said groove with said stacked metal films, removing said second metal film and said first metal film from the surface of said insulating film by chemical mechanical polishing with a polishing liquid 10 containing an oxidizing substance, a phosphoric acid and a protection-layer forming agent, thereby exposing said second metal film embedded in said groove, treating the exposed surface of said second metal film in said groove with plasma of a reducing atmosphere, and allowing a second interconnect layer to adhere 15 onto said second metal film exposed in said groove and to lay over the surface of said insulating film.

21. A method for manufacturing a semiconductor device according to claim 20, wherein said oxidizing substance contains hydrogen peroxide, said phosphoric acid contains one selected 20 from the group of orthophosphoric acid and phosphorous acid, and said protection-layer forming agent contains one selected from the group of benzotriazole and a carboxyl-containing polymer.

22. An electronic circuit device having a multilevel

metallization structure, which comprises plural interconnect layers stacked successively in such a way that any two of said plural interconnect layers have therebetween an insulating layer, thus the number of said insulating layer being one or 5 more in total, and a metal interconnect member or plug embedded in said insulating layer by chemical mechanical polishing for electrically connecting said any two of interconnect layers, wherein the uppermost insulating layer has, together with the metal interconnect member or plug embedded therein, a 10 substantially flat surface level having a flatness of 80 nm or less.

23. A semiconductor integrated circuit device, which comprises a semiconductor substrate having, on the main surface thereof, a first semiconductor region and a second semiconductor region 15 which are separated each other, at least three interconnect layers disposed over said first and second semiconductor regions and stacked successively in such a way that any two of said interconnect layers have therebetween an insulating layer, thus the number of said insulating layer being at least two in total, 20 and a metal interconnect member or plug which is embedded in said insulating layer by chemical mechanical polishing and connects therewith said interconnect layers, wherein said interconnect layers each has a larger metallization density over said first semiconductor region than over said second

semiconductor region, and the uppermost insulating layer and  
said interconnect member or plug embedded therein have, over  
both said first and second semiconductor regions, a  
substantially flat surface level in common with erosion and  
5 dishing suppressed to 50 nm or less.